ENGINEERING AND DESIGN
HYDROLOGIC FREQUENCY ANALYSIS

CHAPTER 1

INTRODUCTION

1-1. Purpose and Scope. This manual provides guidance in applying statistical principles to the analysis of hydrologic data for Corps of Engineers Civil Works activities. The text illustrates, by example, many of the statistical techniques appropriate for hydrologic problems. The basic theory is usually not provided, but references are provided for those who wish to research the techniques in more detail.

1-2. References. The techniques described herein are taken principally from "Guidelines for Determining Flood Flow Frequency" (46)[1], "Statistical Methods in Hydrology" (1), and "Hydrologic Frequency Analysis" (41). References cited in the text and a selected bibliography of literature pertaining to frequency analysis techniques are contained in Appendix A.

1-3. Definitions. Appendix B contains a list of definitions of terms common to hydrologic frequency analysis and symbols used in this manual.

1-4. Need for Hydrologic Frequency Estimates.

a. Applications. Frequency estimates of hydrologic, climatic and economic data are required for the planning, design and evaluation of water management plans. These plans may consist of combinations of structural measures such as reservoirs, levees, channels, pumping plants, hydroelectric power plants, etc., and nonstructural measures such as flood proofing, zoning, insurance programs, water use priorities, etc. The data to be analyzed could be streamflows, precipitation amounts, sediment loads, river stages, lake stages, storm surge levels, flood damage, water demands, etc. The probability estimates from these data are used in evaluating the economic, social and environmental effects of the proposed management action.

b. Objective. The objective of frequency analysis in a hydrologic context is to infer the probability that various size events will be exceeded or not exceeded from a given sample of recorded events. Two basic problems exist for most hydrologic applications. First the sample is usually small, by statistical standards, resulting in uncertainty as to the true probability. And secondly, a single theoretical frequency distribution does not always fit a particular data-type equally well in all applications. This manual provides guidance in fitting frequency distributions and construction of confidence limits. Techniques are presented which can possibly reduce the errors caused by small sample sizes. Also, some types of data are noted which usually do not fit any theoretical distributions.

c. General Guidance. Frequency analysis should not be done without consideration of the primary application of the results. The application will have a bearing on the type of analysis (annual series or partial duration series), number of stations to be included,

[1] Numbered references refer to Appendix A, Selected Bibliography.

whether regulated frequency curves will be needed, etc. A frequency study should be well coordinated with the hydrologist, the planner and the economist.

1-5. Need for Professional Judgment. It is not possible to define a set of procedures that can be rigidly applied to each frequency determination. There may be applications where more complex joint or conditional frequency methods, that were considered beyond the scope of this guidance, will be required. Statistical analyses alone will not resolve all frequency problems. The user of these techniques must insure proper application and interpretation has been made. The judgment of a professional experienced in hydrologic analysis should always be used in concert with these techniques.